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Vaccines delivered systematically to populations in universal immunization programs have so reduced the incidence of some diseases that rare reactions to vaccines have become more visible and more feared than the diseases themselves. Ellenberg and Chen describe how the Vaccine Adverse Events Reporting System works to provide data to help us reduce the small risk associated with vaccines already approved by the Food and Drug Administration (FDA) as "safe and effective." This focus on adverse events is entirely appropriate. The success of immunization strategies for the future depends on vaccines being both more effective and safer.

Safety is more important for vaccines than for most drugs for three reasons:

The Biology of Vaccines and Community Decisions to Vaccinate

Herd immunity. First, an immunization strategy for protecting entire communities can only be effective when *herd immunity* has been achieved. Herd immunity is achieved when there is a sufficient level of vaccine protection in the population to prevent circulation of the disease to those who remain biologically susceptible. Even in a fully

vaccinated population, some individuals remain susceptible to the disease against which the vaccine was administered. No vaccine, even one that works well, is 100% effective at inducing sufficient immunity. Further, not everyone in the population is capable of generating immunity, even to an effective vaccine. But with herd immunity, the likelihood of two susceptible individuals being within range for transmission is very, very small.

Healthy people vaccinated. Second, it is healthy children and adults who take vaccines against diseases they might never contract in order to protect themselves and their communities. Vaccine-related injuries to healthy people are unacceptable to society; in contrast, those already suffering with painful, disabling, or deadly diseases often willingly accept significantly risky therapeutic interventions.

Community's decision. Third, because protection of the population depends on achieving herd immunity, vaccination programs are based on a community's decision that the benefits of an effective vaccination program outweigh its cost. Strategies to protect populations leave little room for an individual to make decisions about risks and benefits for herself or himself. School entry laws that require vaccination before a child begins elementary school reflect this reality. Today, many states require immunization before a child begins group day care or preschool because we have learned the hard way that waiting for grade school entry was too late.

In an era when no one has seen an iron lung and the only traces of polio's scourge is the handful of adults walking with braces or canes, some parents may be tempted to consider skipping the vaccination of their children, thus avoiding the chance in a million of paralysis caused by the vaccine. For residents of the United States it is easy to forget that the polio virus still cripples and kills children in other countries and that their children can be exposed while traveling or through contact with the occasional unimmunized new arrival to this country.

Our democratic society places such a premium on individual liberty and individual decision-making that we feel discomfort with collective or community decisions. Yet the very biology of vaccines makes the choice to employ them far more than a collection of individual decisions. The study of vaccine adverse events is not an effort to provide individuals with a basis for deciding whether to vaccinate but rather an effort to improve the safety and effectiveness of vaccines and, in doing so, to increase confidence in societal decisions that weigh the costs and benefits to the society. It will be far easier to achieve herd immunity when risks associated with vaccines are known to be so small that public confidence in the safety of vaccines is secure.

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